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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G06K 7/08, 7/10 | A1

(11) International Publication Number: **WO 94/16407**

(43) International Publication Date: 21 July 1994 (21.07.94)

(21) International Application Number: PCT/GB94/00044

(22) International Filing Date: 11 January 1994 (11.01.94)

(30) Priority Data:
9300603.9 13 January 1993 (13.01.93) GB

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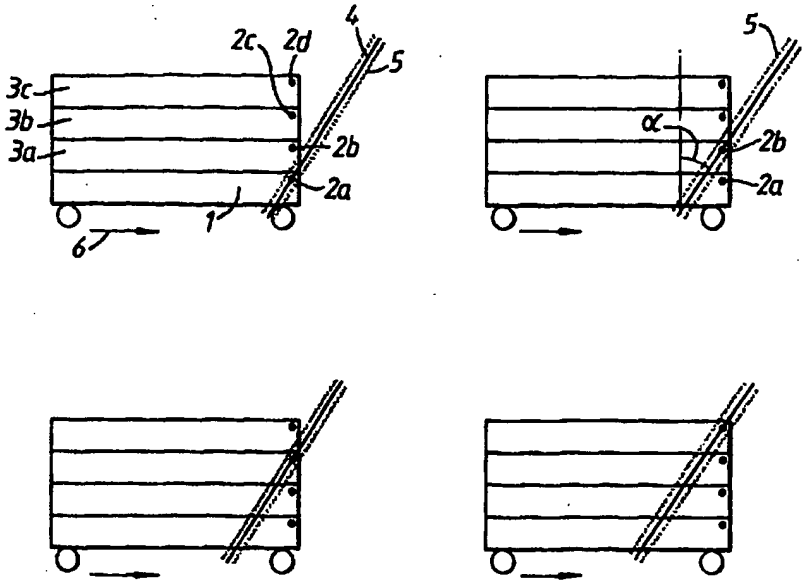
(81) Designated States: AU, CA, JP, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: A METHOD OF, AND A SYSTEM FOR, DETECTING OBJECTS



(57) Abstract

The invention provides a method of, and a system for, detecting the presence of a plurality of objects (1, 3) moving collectively along a direction of travel (6) comprising providing each object with a tag (2) providing a detector having an antenna (4) for detecting the presence of the tag along a detection zone (5) at a first angle to the direction of travel (6), arranging the objects (1, 3) such that the tags (2) are substantially aligned at a second angle to the direction of travel (6) different to the first angle and collectively moving the objects (1, 3) through the detection zone (5). By aligning the tags (2) at a different angle to the direction of travel (6) to that of the detection zone (5) the tags (2) enter the detection zone (5), and are read at different times thus avoiding more than one being read at any given time.

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A METHOD OF, AND A SYSTEM FOR, DETECTING OBJECTS

BACKGROUND OF THE INVENTION

This invention relates to a method of, and a system for, detecting a plurality of objects arranged in stacked relationship. The invention relates, particularly, though not exclusively, to the detection of stacked containers as they leave and enter storage areas in supermarkets.

Produce is often supplied to supermarkets in trays which are made from plastics material and are durable enough to be used very many times. The trays are expensive to replace if they are stolen or otherwise lost, and it is therefore desirable to monitor their whereabouts.

In the past bar codes have been applied to trays and expensive hand-held readers used to "swipe", i.e. read, the barcodes as the stacked trays leave the store. This method is unsatisfactory because the bar codes and the hand-held readers lack durability and also because it is labour intensive.

SUMMARY OF THE INVENTION

According to the invention there is provided a method of detecting a plurality of objects arranged in stacked relationship, comprising providing each object in said plurality of objects with a respective tag, providing a detector having a linear detection zone to sense said

tags and causing relative movement between said plurality of objects and said linear detection zone, wherein the tags are arranged to lie in a line and said linear detection zone is inclined at an angle to said line.

By this method, when there is relative movement between the stack and the detection zone, each tag enters the detection zone of the detector at a different time.

The tags are, preferably, transponders.

The transponders may be passive or active devices and may signal a code identifying the associated object and may also signal other information such as, in the case of a container, the contents of the container.

By a stack is meant an arrangement where the objects are placed one above the other in a vertical direction or side-by-side in a horizontal direction.

Preferably, for convenience of stacking, the detection zone is at an acute angle to the direction of travel whilst the transponders are aligned substantially normal to the direction of travel.

The detector may have an antenna defining the linear detection zone. Preferably the antenna is a loop

antenna since this is easily formed and provides a well defined detection zone because of its narrow reception lobe.

According to a second aspect of the invention there is provided a system for detecting objects arranged in stacked relationship, comprising a plurality of tags, each being associated with a respective object so that the tags lie in a line, and a detector having a linear detection zone inclined at an angle to said line.

DESCRIPTION OF THE DRAWINGS

Methods, and systems according to the invention will now be described, by way of example only, with reference to, and as illustrated by, the accompanying drawings in which:-

Figure 1 shows a sequence of side views as a group of trays pass a detector;

Figure 2 shows comparative side views for two different angles of detection zone;

Figures 3 and 4 show side views of food trays being detected by detection methods using two detection zones; and

Figure 5 shows a side view of a dolly detection system.

DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to Figure 1, a dolly 1 is provided with a transponder 2a during its manufacture. Stacked upon the dolly 1 are a plurality of nominally identical trays 3a,3b and 3c, each having a transponder 2b,2c and 2d respectively. All the transponders are of a known type each having a memory device, a transmitter and receiver. The memory device contains a unique identity code and can also be programmed with a code representing the contents of the tray.

A loop aerial 4 is arranged by a doorway to a storeroom of a supermarket (not shown) at an acute angle to a direction of travel 6 of the dolly 1. The loop aerial 4 has a circumference of 1.8 metres and width of 7.62 cm which produces a detection zone 5 represented by shading in the drawing. The loop aerial 4 is connected to a detector (not shown) which reads and decodes the signals received by the aerial but also alternately transmits via the aerial 4 an r.f. signal.

In this embodiment, the aerial 4 has a 100 mm wide detection zone 5 and the read interval is 70 ms. In the particular example the transponder must leave the detection zone 5 no earlier than 140 ms after entering it in order to read the data satisfactorily. Thus, the dolly 1 is made to move no faster than 0.7 metres/second. The speed may be increased by increasing

the detection zone width or reducing the read time.

In this particular embodiment of the invention, the transponders (2a,2b,2c,2d) are disposed vertically, one above another, and the loop aerial 4 is inclined at an acute angle $\propto$ relative to the vertical.

As the dolly 1 and trays 3 stacked thereon move in the direction of arrow 6 (Figure 1a) transponder 2a enters the detection zone 5. The transponder is powered in a manner well known by energy received during the detector transmission cycle, and using the stored energy, responds with a signal including its unique identifier. Transponder 2a then leaves the detection zone 5 and transponder 2b of the first tray 3a enters (Figure 1b) the zone. This transponder is powered and responds in the same manner as transponder 2a. However, in addition to its unique identifier it also transmits a code representative of the contents of the tray 3a. Similarly, Figures 1c and 1d show the entry of transponders 2c and 2d respectively.

It will be apparent from Figures 1a to 1d that only one transponder is activated and read at a time because the detection zone 5 is relatively narrow and is inclined at an angle to the alignment direction of the transponders. Figure 2 shows how the selectivity of the

detector can be increased by reducing the slope of detection zone 5. As shown in Figure 2a, the separation of the trays is such that the transponders e.g. 2e and 2f of adjacent trays both lie within the detection zone 5 at the same time. The transponders will thus be energised and read at the same time leading to a misread.

To increase the selectivity, the detection zone 5 is made longer and inclined further to decrease the angle between it and the direction of travel 6. Thus in Figure 2b only one transponder lies within the detection zone 5 at any given time.

The arrangement shown in Figure 2b requires a relatively long detection zone 5 and a correspondingly long aerial 4. Where this is inconvenient for reasons of space, a more compact arrangement may be used of two loop aerials and associated detection zones 5a and 5b, as shown in Figure 3. The dolly 1 and trays 3a,3b and 3c pass through and are read by a lower aerial 4b while the remaining trays are read by an upper aerial 4a. In this arrangement two transponders may be read simultaneously but it does not lead to a misread because each aerial 4a,4b feeds a respective channel of the detector.

In another embodiment, the dolly 1 may be loaded with two vertical stacks 7 and 8 of trays side-by-side, as

shown in Figure 4. This can lead to two transponders being read simultaneously as shown in Figure 4a, leading to an ambiguity. Figure 4(b) shows an arrangement provided with two aerials 4a, 4b spaced apart in the direction of travel 6 and arranged to read upper and lower trays of the stacks respectively. The aerials 4a,4b supply the signals to the same receiver channel but no ambiguity results because of the spatial separation of the detection zones which ensures that only one transponder lies in a detection zone at a given time.

In some circumstances, for example, automated stock control systems in warehouses, it may be desirable to determine how the trays are stacked on the dolly. For instance, in the case of a dolly containing more than one stack, the distribution of trays amongst the stacks can be determined by running the dolly past the detector at a controlled speed and noting the relative times at which the transponders are read. For example, if it takes 1 second for the dolly to move past the antenna, readings made after 0.5s will be derived from trays in the trailing stack on the dolly. Alternatively, a beam interruption method could be used to detect tray positions.

Figure 5 shows a preferred method in which an additional

loop aerial 9 having a castellated form of detection zone aligned with the direction of travel is used to read and hence detect the position of the dolly transponder 2a as it crosses the castellations 9a to 9e. In this way it is possible to determine the position of the tray which is being detected within the detection zone by correlating it with the position of the dolly 1 detected by the loop aerial 9.

In some embodiments it may be possible to reprogramme the transponders as the trolley passes the aerial to update the codes they carry to indicate new contents carried by the tray.

Whilst in the described embodiments the trays are moved past the detection zone in other embodiments the detection zone may be arranged to pass the trays.

INDUSTRIAL APPLICABILITY

The invention has applicability to methods and systems for the detection of stacked objects, particularly though not exclusively, such objects as are stored in warehouses, supermarkets and the like.

CLAIMS

1. A method of detecting a plurality of objects arranged in stacked relationship, comprising providing each object in said plurality of objects with a respective tag, providing a detector having a linear detection zone to sense said tags and causing relative movement between said plurality of objects and said linear detection zone, wherein the tags are arranged to lie in a line and said linear detection zone is inclined at an angle to said line.

2. A method as claimed in claim 1 wherein the tags are transponders.

3. A method as claimed in claim 2, wherein the stack is moved in a direction of travel relative to the detector, the detection zone being at a first angle to the direction of travel; arranging the objects such that the transponders are substantially aligned at a second angle to the direction of travel different to the first angle and collectively relatively moving the objects through the detection zone.

4. A method as claimed in claim 3, wherein the transponders are aligned substantially normally to the direction of travel.

5. A method as claimed in claim 2 or claim 3 or claim 4, wherein the transponders comprise radio frequency transponders and the detector comprises a loop antenna a major plane of which is parallel to the detection zone.

6. A method as claimed in any preceding claim comprising providing a carriage means for carrying the stack in a direction of travel and stacking the objects onto the carriage means.

7. A method as claimed in claim 6 comprising providing the carriage means with a carriage tag by means of which the carriage means is detected by the detector.

8. A method as claimed in claim 7, wherein the carriage tag is a transponder.

9. A method as claimed in claim 8 comprising providing the detector with carriage detecting means for detecting the presence of the carriage transponder at a number of positions along the direction of travel.

10. A method as claimed in any of claims 2 to 9, wherein the detector detects a line of transponders

along a second detection zone at an angle to the line of transponders.

11. A method of detecting the presence of a plurality of objects arranged in stacked relationship substantially as hereinbefore described with reference to the drawings.

12. A system for detecting objects arranged in stacked relationship comprising a plurality of tags, each being associated with a respective object so that the tags lie in a line, and a detector having a linear detection zone inclined at an angle to said line.

13. A system as claimed in claim 12, wherein the tags are transponders.

14. A system as claimed in claim 13, wherein the detection zone and the line of transponders are arranged at different angles to a direction of relative motion of the stack.

15. A system as claimed in claim 14, wherein the detection zone is at an acute angle to the direction of relative motion.

16. A system as claimed in claim 13, claim 14, or

claim 15, wherein the line of transponders is substantially normal to the direction of relative motion.

17. A system as claim in any of claims 13 to 16, wherein the objects are nominally identical and are provided with transponders at nominally identical locations.

18. A system as claimed in any of claims 13 to 17, wherein the transponders are radio frequency transponders and the detector comprises a loop antenna a major plane of which is parallel to the detection zone.

19. A system as claimed in any of claims 12 to 18 comprising carriage means, having loaded thereon the stack, by means of which the stack is relatively moved through the detection zone.

20. A system as claimed in claim 19, wherein the carriage means comprises a carriage tag by means of which the carriage means is detected by the detector.

21. A system as claimed in claim 20, wherein the carriage tag is a transponder.

22. A system as claimed in claim 21, wherein the

detector includes carriage detecting means for detecting the presence of the carriage transponder at a number of positions in the direction of relative motion.

23. A system as claimed in claim 22 wherein the carriage detecting means comprises an antenna having a plurality of spaced apart detection zones in the direction of relative motion.

24. A system as claimed in any of claims 13 to 23, wherein the detector has a plurality of linear detection zones.

25. A system as claimed in claim 24, wherein the detection zones are spaced apart in a direction normal to a direction of relative movement between the stack and the detection zones, the objects being arranged in at least two sets, and the detector further comprising respective detector channels for the detection zones such that returns are received from a transponder in each set substantially simultaneously.

26. A system as claimed in claim 24, wherein the detection zones are spaced apart in a direction of relative movement between the stack and the detection zones, and spaced apart in a direction normal to the

direction of relative movement, such that, a first set of transponders is detected within a first detection zone and a second set of transponders is subsequently detected within a second detection zone.

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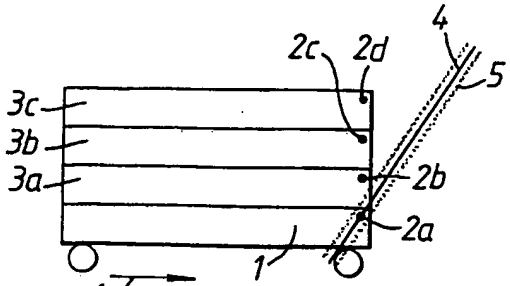

Fig.1a

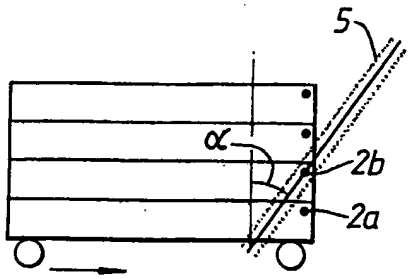

Fig.1b

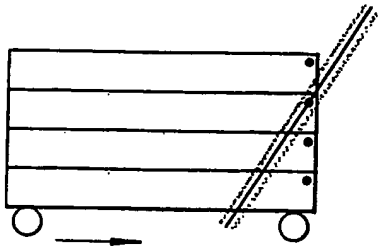

Fig.1c

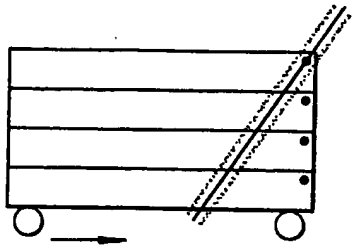

Fig.1d

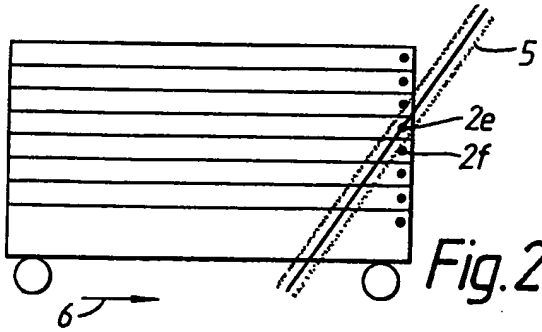

Fig.2a

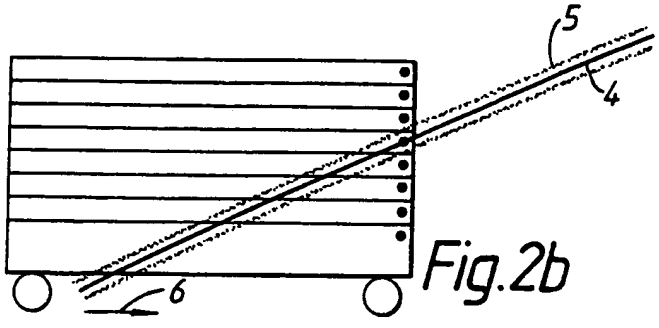

Fig.2b

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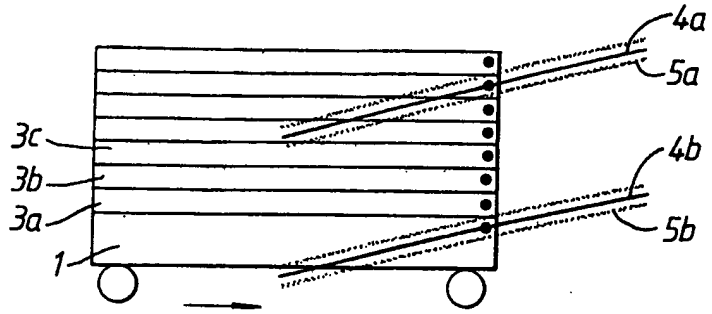


Fig.3

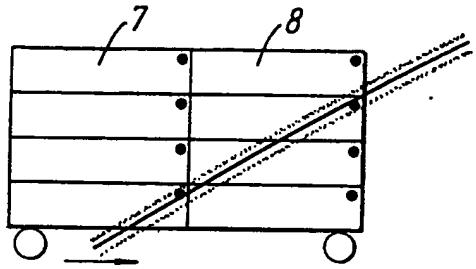
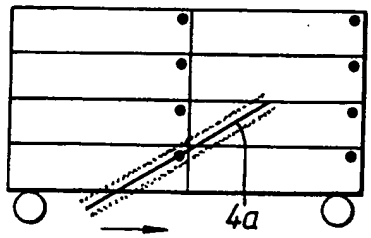


Fig.4a



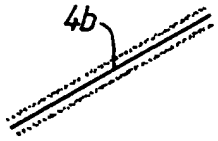


Fig.4b

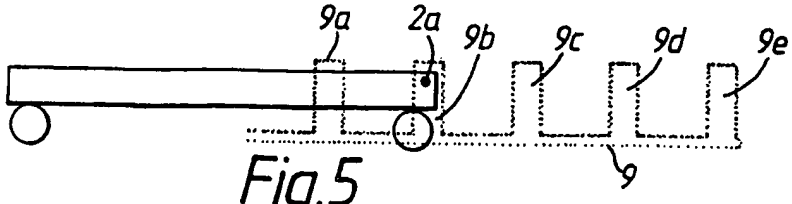


Fig.5

INTERNATIONAL SEARCH REPORT

Inten nal Application No
PCT/GB 94/00044

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 G06K7/08 G06K7/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 G06K B65G

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,85 02282 (RADIATION DYNAMICS) 23 May 1985 see page 11, line 33 - page 13, line 8; figures 1-4	1-3,6-9, 12-15, 17,19-23
X	EP,A,0 494 764 (TEXAS INSTRUMENTS) 15 July 1992 see the whole document	1-3,10, 12-15,24
X	EP,A,0 496 611 (TEXAS INSTRUMENTS) 29 July 1992 see the whole document	1-3, 12-15
A	EP,A,0 120 729 (L'OREAL) 3 October 1984 see abstract; figures 3-5	1,12

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[X] Further documents are listed in the continuation of box C.

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31 March 1994	13. 04. 94

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 322 701 (OMRON TATEISI ELECTRONICS) 5 July 1989 see column 1, line 20 - line 52; figure 1	1

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INTERNATIONAL SEARCH REPORT

information on patent family members

Inter ...nal Application No
PCT/GB 94/00044

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